Preliminary Report on The Estimated Benefits of Grid West

Risk/Reward Work Group

Seminar

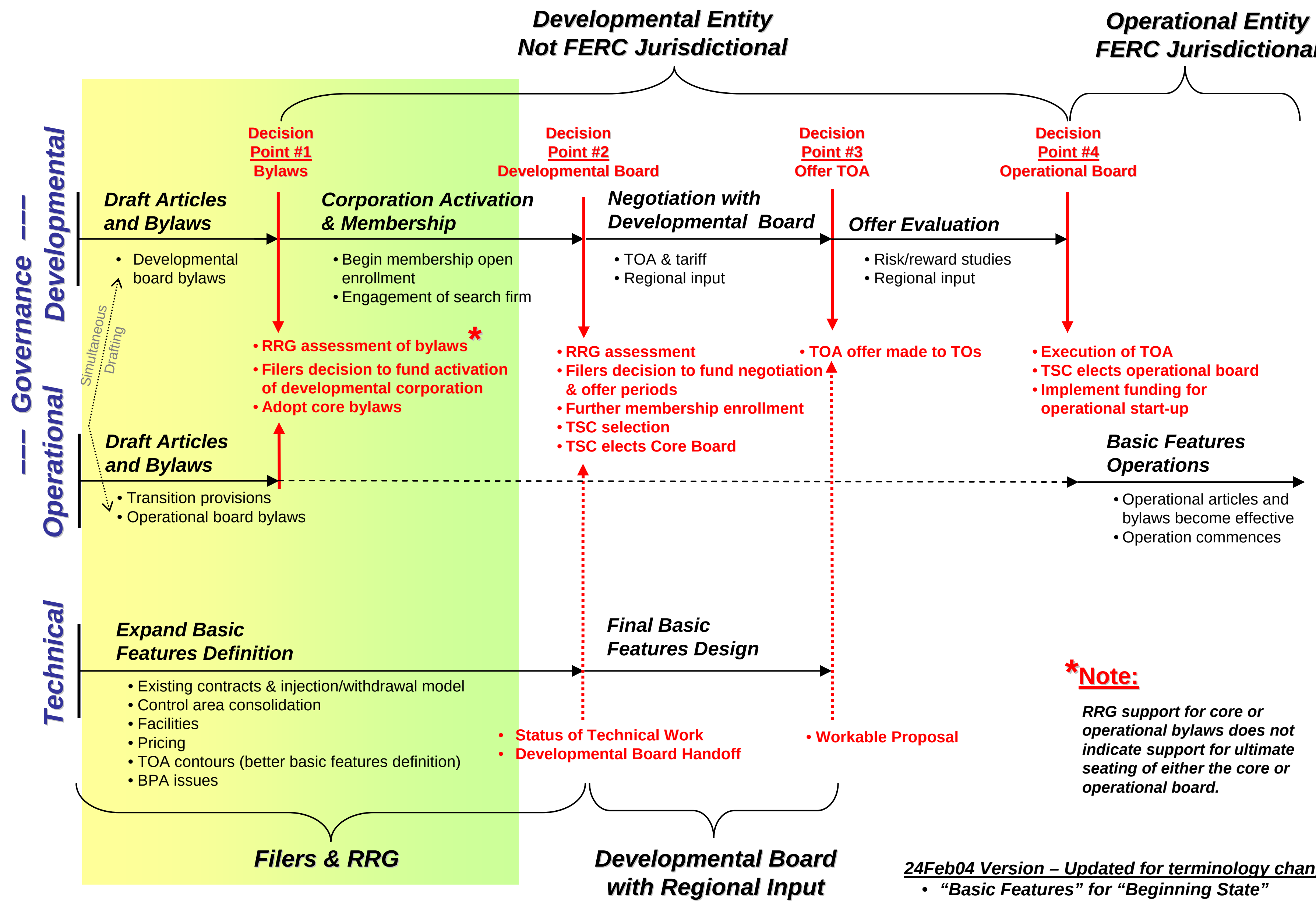
July 20 – 21, 2005

Volume 1, Wednesday, July 20

Introduction and Background

- ***Opening Remarks***
  - Grid West Process Overview
  - Framing Questions
- ***Information Resources and Documents***
  - Documentation of efforts
  - Recommendations for further analysis
- ***Background and Purpose***
  - Assignments
  - Tasks
  - Findings

Process Diagram



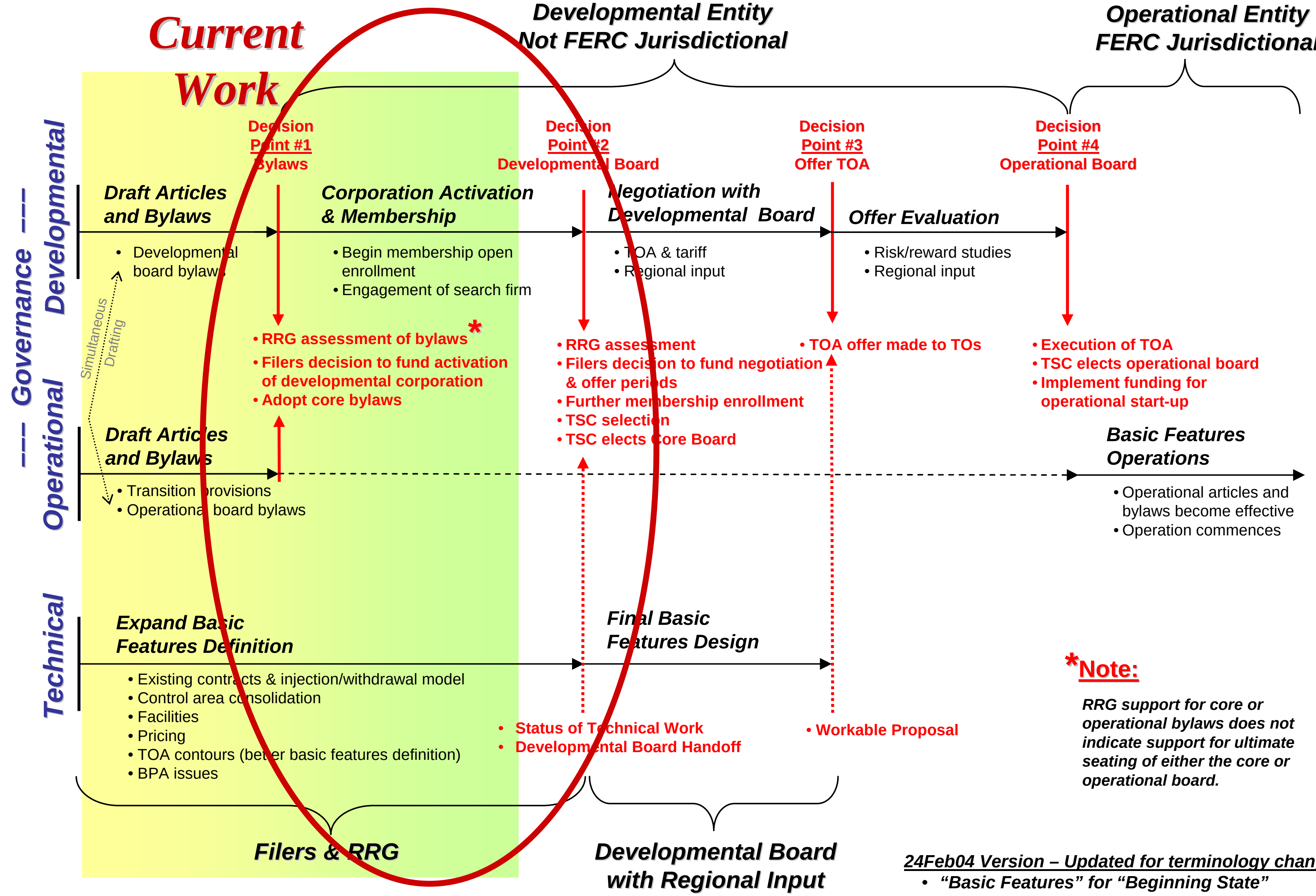
24Feb04 Version – Updated for terminology changes:

- *"Basic Features" for "Beginning State"*
- *"Developmental Board" for "Core Board"*

Notes on Process Diagram Work Streams

- ***Governance:***
  - Prepare bylaws to enable seating of the Developmental Board.
  - Four decision points established for moving through development process to the beginning of operations:
    1) Bylaws
    2) Developmental Board
    3) TOA Offers to Transmission Owners
    4) Operational Board
- ***Technical:***
  - Expand the definition of the operational entity's basic features, *as much as possible* by Decision Point #2, to assist the RRG assessment (the conceptual framework)
  - Technical work completed is to be "handed off" to the Developmental Board for completion as part of Transmission Agreement and Tariff Development (protocols, tariffs, etc.)

Process Diagram



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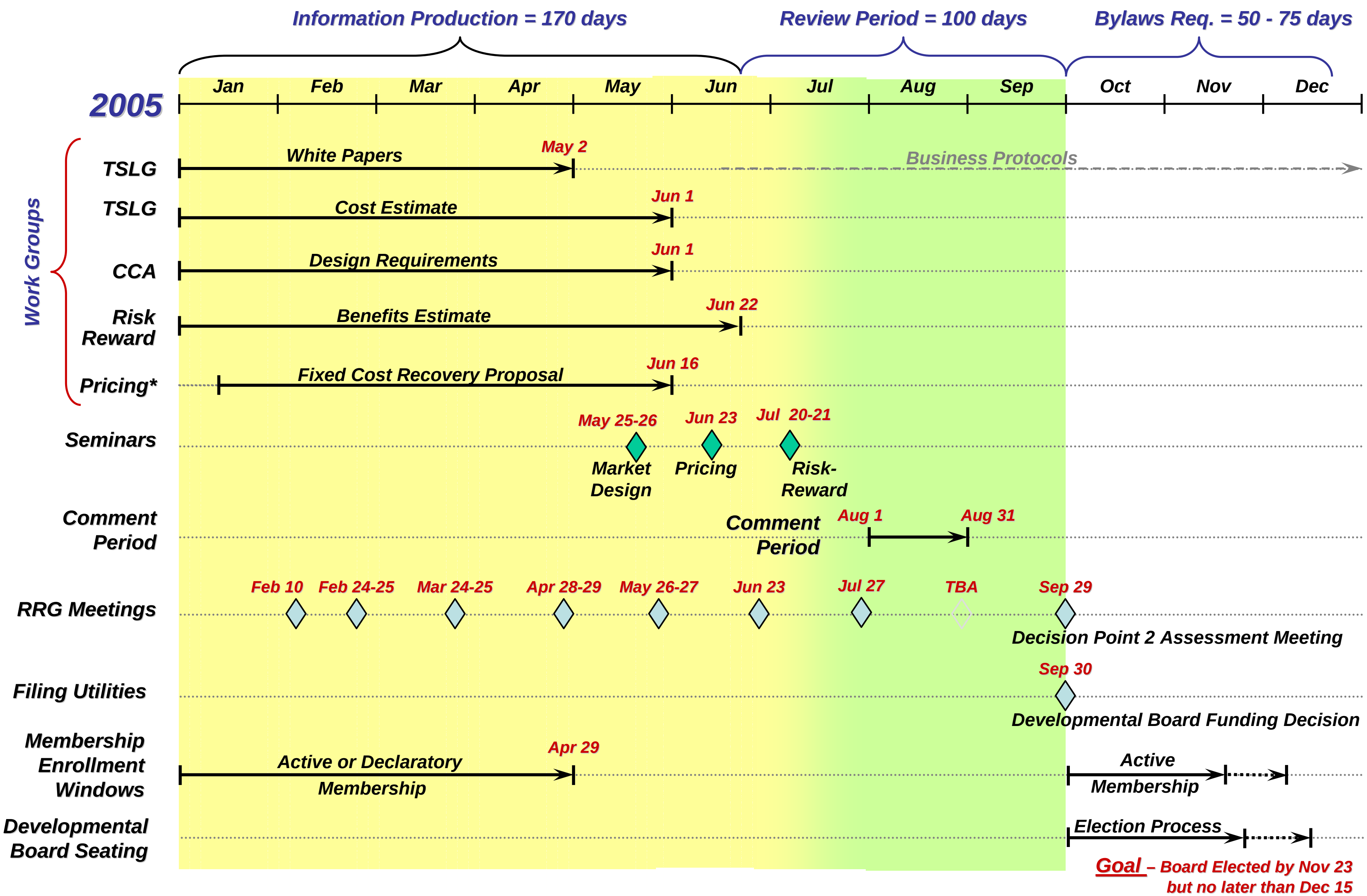
Timelines for Developmental Board Seating



Framing Questions

- ***Validity of Analysis***
  – Clarity and accuracy of assumptions
  – Methods used in analysis
  – Limitations of models and data available
  – Confidence in results
- ***Comparison to Cost Elements***
- ***Areas for Further Analysis***
  – See specific items in report

Information Resources and Documentation

- ***Report: <u>Preliminary Report on The Estimated Benefits of Grid West</u>***
  - July 19th Seminar Review Draft
  - Posted today, hardcopies available now
- ***Appendices***
  - Available electronically only (zip file)
  - Will be posted by Friday, July 22
- ***Glossary***
- ***References (internal and external documents) are hyperlinked***

Ground Rules for Seminar

- ***We're all here to learn***
- ***There's a lot to cover***

  →we'll need to keep the pace moving

  – Speakers are being timed
- ***Questions and Responses:***
  – If possible "here's the answer..."
  – If not "need to think about the question" or "need to research the question and come back later with and answer."
  – We'll try to record all questions and compile a list with responses.
- ***Written questions can be submitted after the seminar***
  – Send to Kurt at kconger@nrgxs.com

Background and Purpose

Background

- **Three areas of study:**
  - Review existing studies that evaluated costs, benefits and risks
  - Quantify the impact of the RRG-identified problems
  - Research the operating costs of ISOs and RTOs
- **The workgroup chose not to engage in production cost modeling...**

  ... but did not preclude modeling efforts by individual group members

Background - Tasks

- **Review existing studies**
  - Rate Pancakes, operating reserves, reliability, etc.
- **Survey regional participants**
  - 37 questions following the RRG-defined Problems/Opportunities
  - Qualitative and quantitative information requested and received
  - 91% response rate
- **Coordinate assessment of benefits with the Consolidated Control Area effort**
  - *Contingency reserves*
  - *Regulation reserves*
  - *Redispatch efficiencies (Real-time Energy Imbalance)*
  - *Reconfiguration service*
  - *Reliability*
- **Coordinate cost information with the TSLG/The Structure Group**
- **Identify qualitative benefits**
- **Identify risk elements**

Purpose

- **Inform RRG and regional stakeholders for Decision Point 2**
  - *Work that has been done*
  - *Potential further analysis*
- **Quantitative Assessment of Benefits**
  - *Models*
  - *Assumptions*
  - *Results in Ranges*
    - *Base Case*
    - *4 control area consolidation/ 10 control area consolidation*
    - *High/Medium/Low*
- **Qualitative Assessments of Benefits**
- **Unquantitified Risk Elements**

Seminar Participant Benefits Worksheet

	Preliminary Estimate of Quantifiable Benefits									
		4 Consolidating Control Areas				**10 Consolidating Control Areas**				**Seminar Participant Workspace**
		High	Medium	Low		High	Medium	Low		
	Cost Saving Category		$ million/year				$ million/year			
1	Contingency Reserves	39	30	20		73	55	37		
2	Regulating Reserves	10	8	5		26	21	14		
3	Redispatch Efficiencies (PowerWorld simulations)	61	56	41		412	332	105		
4	Bulk Electric System Reliability - Cascading Disturbances	83	50	27		83	50	27		
5	Power Delivery System Reliablity - Momentary, Sustained Outages (2002$)	98	58	17		203	119	36		
6	Rate Pancakes (TCA, GridView, Henwood)	61	20	3		61	20	3		
7	Reconfiguration-Transmission Utilization (GridView)	52	30	18		52	30	18		
	Totals ($millions per year)									

Seminar Participant Benefits Worksheet

Unquantified Qualitative Items			Benefit Estimates				
			High	Medium	Low		**Participant**
	Cost Saving Category		$ million/year				**Workspace**
	Improved Transmission Planning						
	Long-term Siting Efficiencies						
	Construction Deferral (G, T and D)						
	Conservation and Demand Side Management						
	Load Following						
	Market Innovation						
	Market Monitoring						

Estimates of Quantifiable Benefits

Contingency Reserves

- ***Base Case:***
  - Each control area supplies 5% hydro/7% thermal from own resources
- ***Grid West Case:***
  - Reserves supplied by Grid West reserve markets
- ***Source Materials:***
  - Tabors Caramanis Study
    - $150 M benefit for Western Interconnection
  - Henwood Study
    - $73 M benefit for Grid West
- ***Assumptions:***
  - High: 100% of Henwood Med: 75% Low:50%
  - 4 CCA v 10 CCA prorated by energy load to the 4 consolidating
- ***Benefits***

Range	*4 CCA*	*10 CCA*
High	*$39*	*$73*
Medium	*$30*	*$55*
Low	*$20*	*$37*

→ Survey responses indicate that increased reserve market scope is possible.

Regulating Reserves

- ***Source Materials:***
  - McReynolds (2000 Referenced in October 2000 RTO West study)
  - McManus (2005 conducted for this report)
- ***Source of Benefit: Ability to respond most effectively to intra-hour load variations***
  - Less wear and tear on machines
  - Consolidated area load diversity reduces overall requirement in the CCA
  - Freed up generating capacity that can be used for other purposes
  - Potential ability to reduce regulating reserve using a relaxed control approach under NERC Control Performance Standard (CPS1)
- ***Studies performed by BPA: load diversity studies***
  - 10 second load data analyzed
  - 10, 30 and 60 minute rolling averages
- ***Assumptions: Capacity Savings Benefits***
  - High includes relaxed control standard

Range	*4 CCA*	*10 CCA*	*Capacity Cost per mo.*
High	141 MW	364 MW	$6/kW
Medium	109 MW	295 MW	$6/kW
Low	109 MW	295 MW	$4/kW

- ***Benefits: ($M per year)***

Range	*4 CCA*	*10 CCA*
High	$10	$26
Medium	$8	$21
Low	$5	$14

Redispatch Efficiencies

- ***Basis for Study***
  - Measurement of benefits of consolidating control areas
  - Implementation of Real-time Balancing Service (RBS)
  - Redispatch market within CCA – utilizing all physically available transmission system capability (security constrained economic dispatch)
  - Eliminating real-time schedule constraints within the CCA – no Scheduled Interchange within consolidated areas
  - Larger pool of generating resources available for real-time dispatch
  - Flow-based, netting, reduction of transmission reserve margin (TRM), Capacity Benefit Margin (CBM)

Base Case Description

- 4 Seasons light-load and heavy-load hour WECC operating cases used for individual control area to control area schedules and net scheduled interchange.
- June 14, 2004 disturbance case used as the spring, LLH case, based upon actual interchange scheduled.
- These cases were used to analyze performance over a “typical” year.

Grid West Case:
Consolidated Control Area Cases

- *4 Control Areas Consolidated*
    - BPA
    - PAC – East
    - PAC – West
    - Idaho Power Company

- *10 Control Areas Consolidated*
    - – BPA, Idaho, PACW, PACE, Avista, British Columbia Transmission Corporation, NorthWestern Energy, Portland General Electric, Puget Sound Energy and, Sierra Pacific.

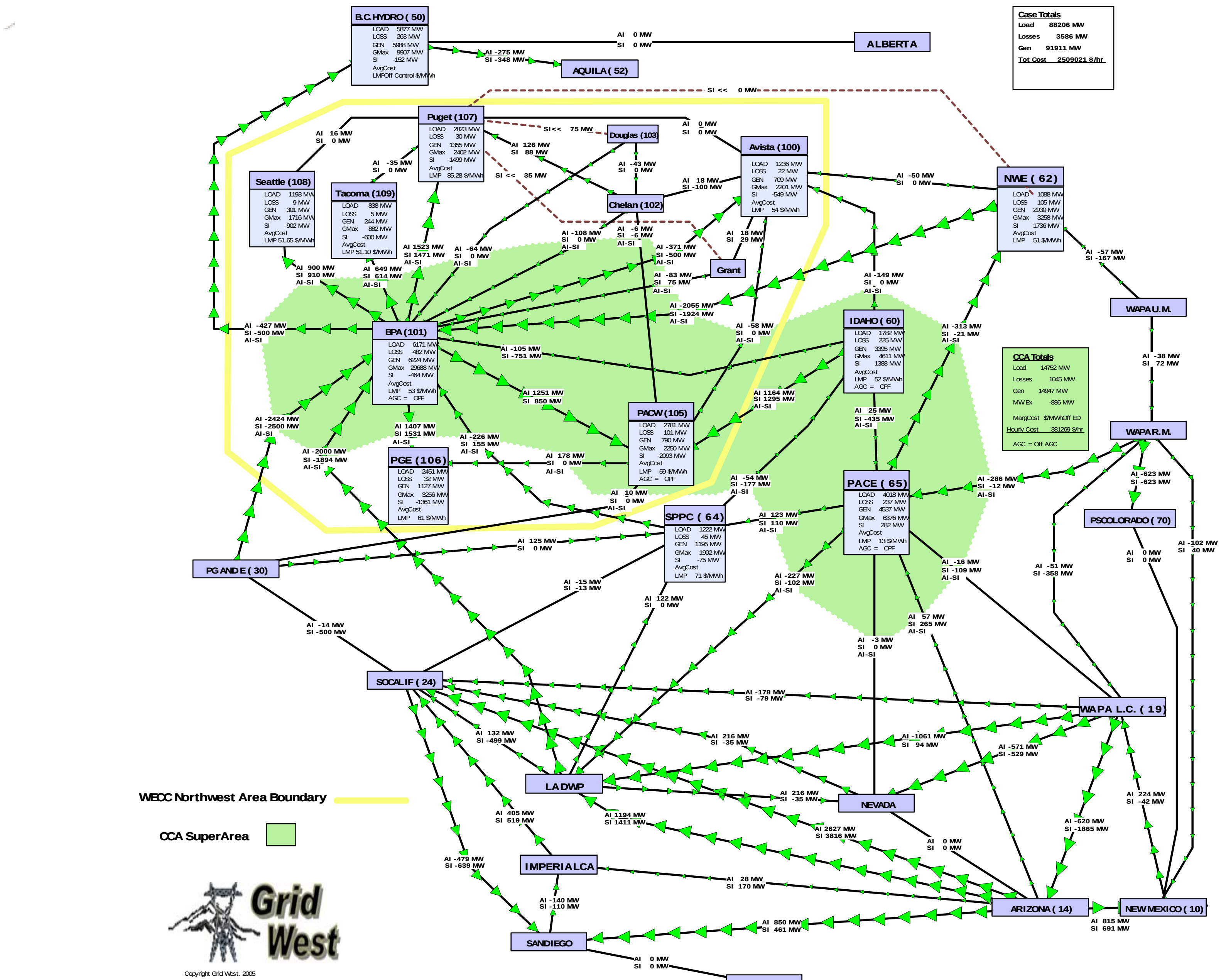
Assumptions

- WECC max/min generator limits
- WECC data reflects actual interchange schedules
- Attempted to replicate actual operations (e.g., dynamic schedules, discretionary and non-discretionary hydro dispatch)
- SSG-WI and RMATs variable costs for thermal units
- Sensitivities on Hydro opportunity costs ($20; $30; $40; $50; $65/MW-hour; Dow Jones average Mid C and weighted average)

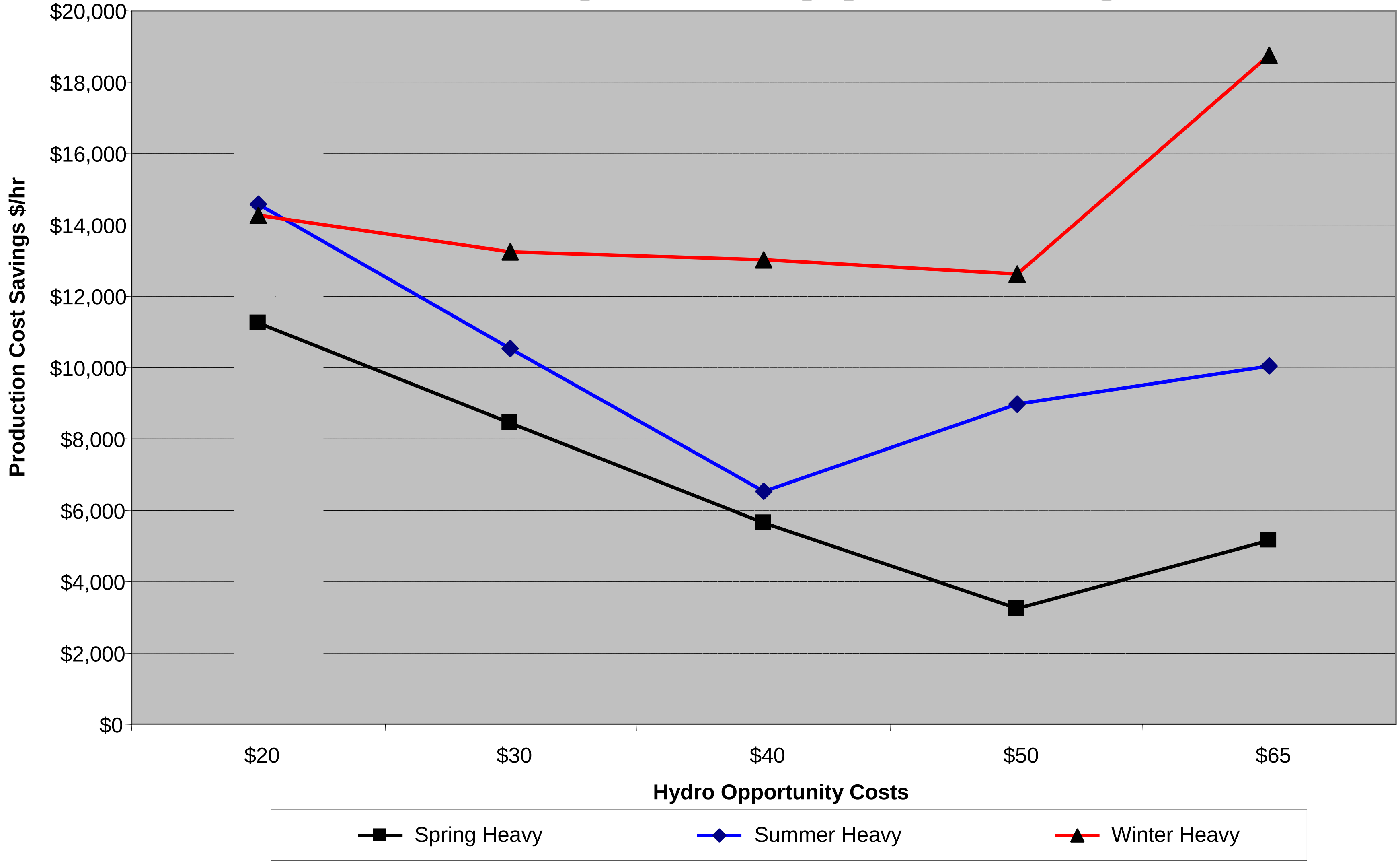
Modeling Approach

- ***PowerWorld Simulator***
  - Time domain simulation of electric power grid
    - Models defined for a representative one-hour period
  - Solves Optimal Power Flow in individual Control Areas while holding Net Scheduled Interchange constant as as proxy for CA generation dispatch
    - Economic Dispatch constrained by system physical limits
    - Individual control areas or consolidated control areas
  - Topology changes to WECC operating cases
    - Separated WECC Northwest Area into separate control areas
    - Added flowgates and detailed path ratings
    - Modeled dynamic schedules
    - Load following scheduled most hydro in the CCA (limited amount of hydro available for Real-time Balancing Service)

Western Interconnection Area-to-Area Interchange

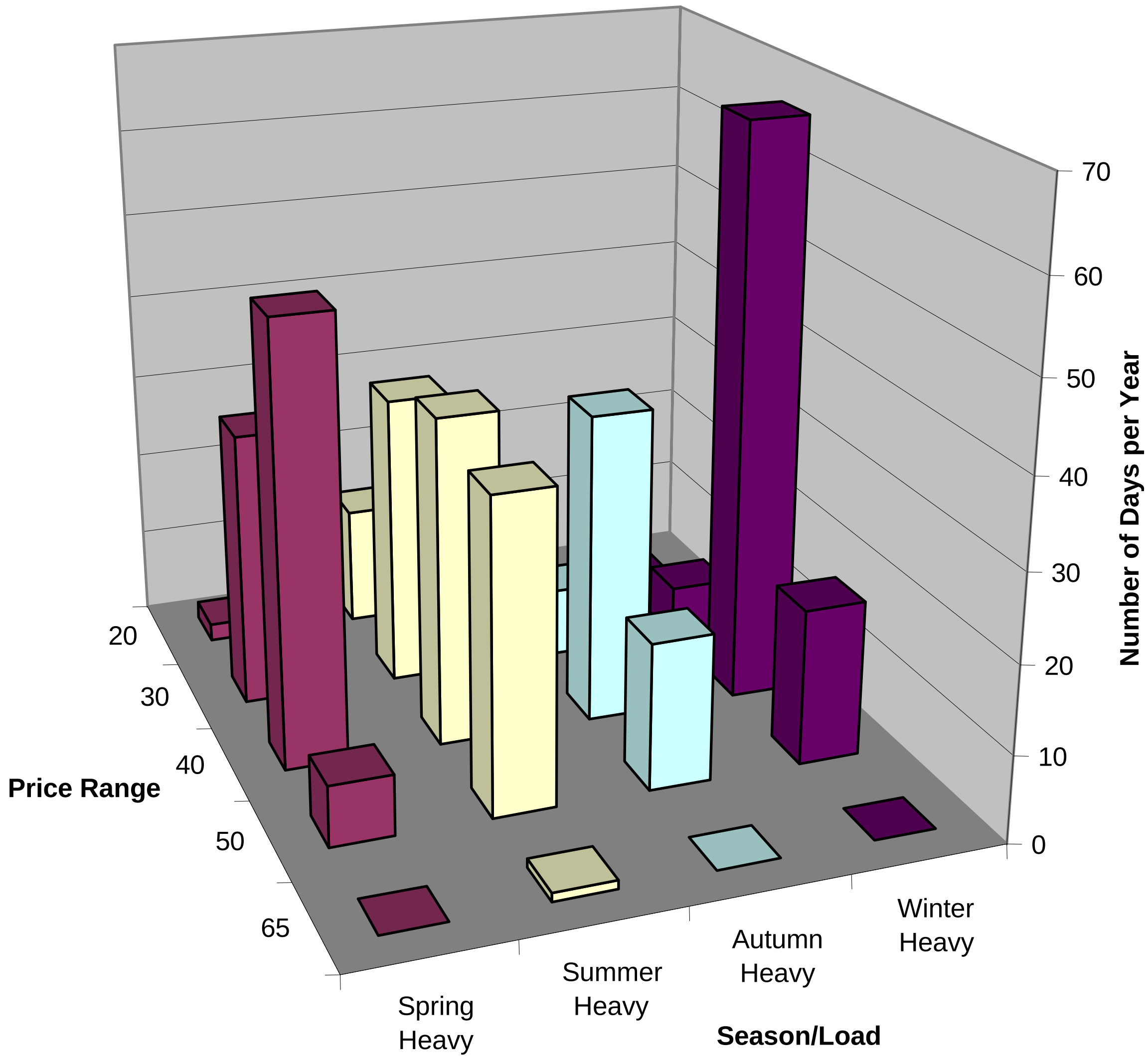


Production Cost Savings v. Hydro Opportunity Cost



4 CCA Cases

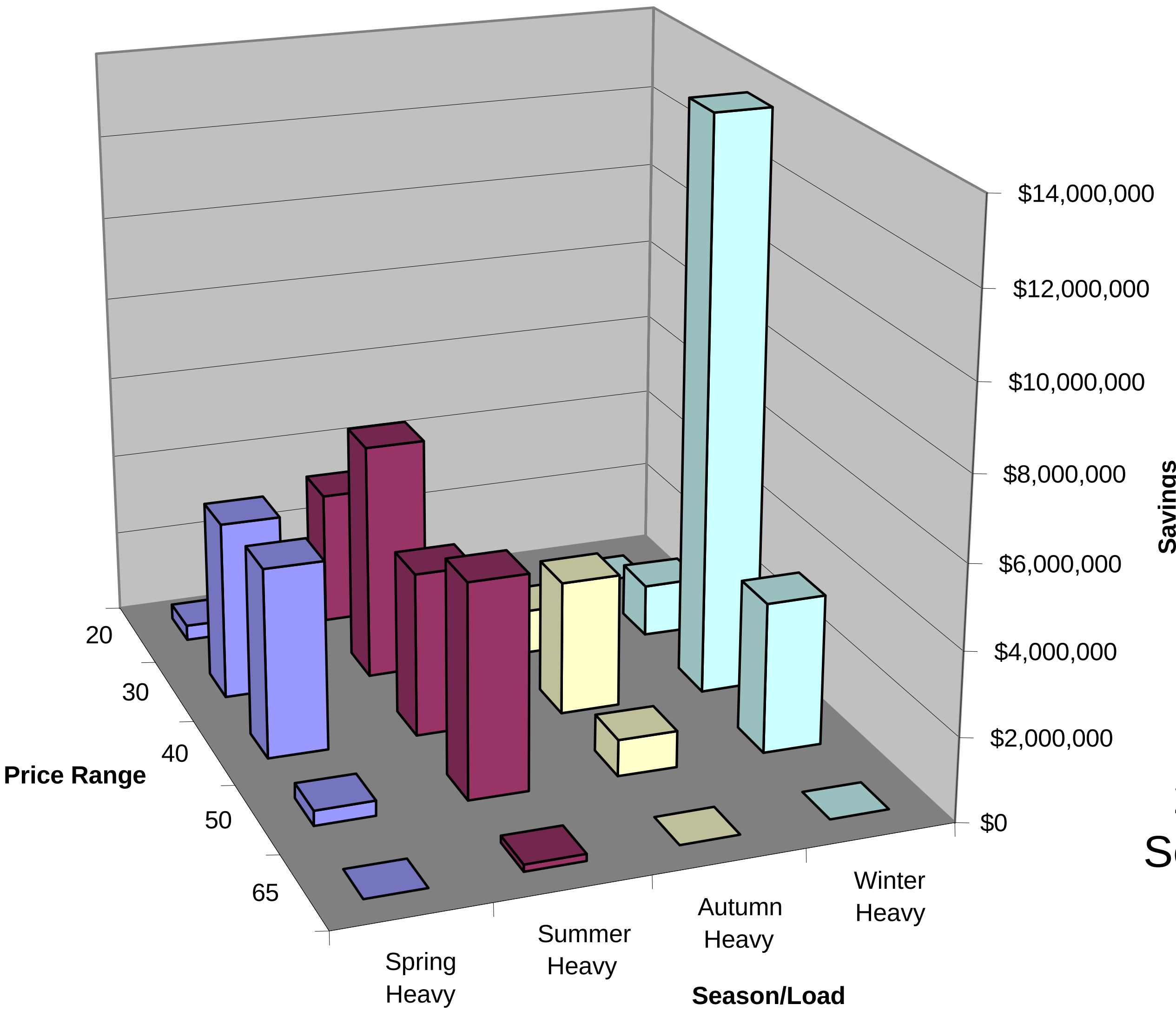
Price Frequencies for Annualization



2004 Data Series

HLH = 16 hrs/day

Resulting Product: Annualized Production Cost Savings



2004 Data Series – HLH Example

Redispatch Efficiency Benefit Estimates

Range	***4 CCA***	***10 CCA***
High	***$61***	***$412***
Medium	***$56***	***$332***
Low	***$41***	***$105***

Note: Units are in millions per year

Break

Please be back in 10 minutes

Value of Increased Reliability

Massoud Jourabchi

Janelle Schmidt

Grid West Policies Affecting Reliability

– Wide visibility of operating data
– Independent centralized state estimator
– Single combined operation and control to flowgate nomogram limits
– Centralized planning with reliability backstop authority
– Outage Coordination
– Single operation of Consolidated Control Area (CCA)
– Re-dispatch market and congestion re-dispatch
– CCA Balancing Market Flow Based ATC & Scheduling
– Independent oversight and use of “best practices” for O&M by Grid West

Historical Analysis of Outages and How Grid West Might Have Affected them

- ***Mittelstadt analysis***
  - Looked at 20 outages culled from NERC data that occurred over the last 12 years
  - Examined cause of outages (26 different categories)
  - Correlated cause of outage to Grid West Policies.
  - Determined that 45% of WECC outages might have been “correctable” by Grid West policies.
  - Only looked at a sampling of large scale grid outages – not more common outages
- ***PAC analysis***
  - Looked at 31 out of 36 disturbances reported to WECC since 1999.
  - Using reported cause/s of outages correlated cause of outage to Grid West policies.
  - Determined that at least 20% of the WECC outages could be mitigated.
  - Only looked at a sampling of outages – not comprehensive

Types of Outages

- ***<u>Momentary outage</u> events lasting less than 5 minutes.***
- ***<u>Sustained outages</u> of greater than 5 minutes typically less than 12 hours, mostly in a single utility area.***
- ***<u>Cascading</u> large scale grid region wide prolonged outages (one in 15-20 year events)—can overlap with sustained.***

Quantitative Estimates Cascading Outages

- ***Method:***
  - GDP displacement
  - Similar to that used for assessing cost of the August 14, 2003 Blackout
  - Referenced in the final Blackout report.

Assumptions...

If:

- ***2004 Gross Product for Grid West Region***
  - based on BEA and BC data for MT, ID, UT, OR, WA, WY
  - US $761,208 million
- ***85% of production occurs on weekdays and 15% on weekends. (based on US Census Bureau wage/earnings data).***
- ***Grid West avoids 1 catastrophic outage of 1 productive day every 20 years or it avoids 1 catastrophic outage of 1 productive day every 15 years.***
- ***If there is an outage, 50% of the day's GDP is lost, the rest will be recovered in future production or was protected by back-up generators.***

Assumptions...

- ***1 weekday's GDP = $2,489,000,000***
- ***1 weekend day's GDP = $1,098,000,000***
- ***1 catastrophic outage of 1 day reduces GDP by $548,948,000 to $ 1,244,283,000.***
- ***Annualizing that over 20 years means annual reliability savings resulting from Grid West would be*** $27 million to $62 million every year.
- ***If that same outage were avoided every 15 years, the annualized benefits would be***

  $37 to $83 million per year.

This Estimate Is Conservative Because:

- ***It does not take into account the growth in GDP that will occur in the out years – it is based on 2004 data.***
- ***It assumes that GDP will be reduced by 50% for every day of lost productivity, as opposed to 100% assumed in other studies.***
- ***It does not take into account the following costs often associated with catastrophic outages:***
  - Spoilage of stock on hand
  - Agricultural losses
  - Utility level costs of a blackstart
  - Potential costs of unrest (riots, looting,etc.)
- ***It does not count the costs outside of WA,OR,UT,ID, WY and MT of an outage (i.e., CA, AZ, NV, etc.)***
- ***If you made the same assumptions about the whole WECC, You would get additional savings of $68 to $200 million /year.***

Momentary and Sustained Outages

- *There is no universal and consistently applied measurement for the more common and localized outages, Momentary or Sustained outages.*

- *IEEE has established standard definitions for Sustained Average Interruption Duration Index (SAIDI) and Momentary Average Interruption Frequency Index (MAIFI) to allow for better consistency of data, however improvements are needed.*

- *Between 1990 and 2001 BPA reported over 13000 outages at its PODs.*
- *Over 8500 outages were momentary,*
- *About 4500 outages had durations over 5 minutes*
- *On average annually there were about 1100 outages in the BPA system.*
- *PacifiCorp data for 2003-2005 shows that there were between 4.6 and 5.6 million customer-hours of transmission related outages.*

On average, 10% of all outages are transmission related

Grid West

Economic Cost of Outages

- *Independent national study conducted by LBL in 2004 showed that Momentary and Sustained outages are most costly form of outages.*
- *LBL estimated that on average annually these type of outages are costing the US economy about 80 billion dollars.*
- *LBL estimated the annual outage cost to NW economy to be about $2.8 billion.*

- *Nationally customers cost of outages are 0.07 percent of GNP*
- *For the WECC cost of outage are about 0.1 percent of total GSP for the region.*
- *Customer's outage costs do not enter into the utility balance sheet except through cost of mitigating them.*
- *LBL study and our own investigation clearly shows that there are not sufficient transparency and consistency in measuring these types of outages to get a real picture of the cost to the customers.*

- *These type of outages are not attention grabbing, not news worthy. And not as much attention is paid to them.*

LBL estimated Outage Cost-per-Outage-per Customer (2002$)

Region	Outage Duration	Residential	Commercial (Small C&I)	Industrial (Large C&I)
Mountain	Momentary Sustained	3 4	583 981	1875 3928
Pacific	Momentary Sustained	2 2.5	604 1050	1881 4111
US total	Momentary Sustained	2 3	605 1067	1893 4227

Impact of Grid West on Reliability

– Major immediate benefit from increased reliability of transmission system will be felt by reductions in customer costs

– BPA review of the major past outages showed that nearly half outages in the past years could be mitigated through Grid West.

– Using LBL analysis and BPA's findings the total potential for reducing customer's cost is over $145 million dollars.

Range of Customer Benefits ($M)

	4 CCA Case			10 CCA Case		
Mitigation	High	Base	Low	High	Base	Low Range
%	70%		-70%	70%		-70%
5%	25	14	4	51	30	9
10%	49	29	9	102	60	18
20%	98	58	17	203	119	36
30%	148	87	26	305	179	54
40%	197	116	35	406	239	72
50%	246	145	43	508	299	90

Utility Benefits from Increased Reliability

- Reduced regulatory requirements for significant increase in the transmission investments in response to increased outages.
- Reduced O&M costs in the long-term.
- Better economy of scale in response to outages
- Reduced cost of generation
- Reduced cost of blackstart
- Etc.

Rate and Transactional Pancakes

Pancaking Assumptions

– Baseline: Wheeling costs are charged on a per control area basis ("pancaking").

Transactions involving multiple charges

	$/KW/month	$/MW-hour
Avista:	$1.40/kW/month	$1.89/MWh
BPA (2 segments)		
PTP-06:	$1.216/kW/month	$1.64/MWh
IS-06:	$1.211/kW/month	$1.63/MWh
BCTC: ($US)	$3.60/kW/month	$4.86/MWh
Idaho Power:	$0.97/kW/month	$1.31/MWh
NorthWestern:	$3.10/kW/month	$4.19/MWh
PacifiCorp:	$2.025/kW/month	$2.74/MWh
PGE:	$0.52/kW/month	$0.71/MWh
Puget:	$0.32/kW/month	$0.31/MWh
Sierra/Pacific		
Zone A:	$2.88/kW/month	$3.89/MWh
Zone B:	$1.40/kW/month	$1.89/MWh

– Grid West Case: Scheduling rights of 1 year or less are purchased on an injection-withdrawal basis, through Grid West.

Three Studies

- ***TCA Study - March 11, 2002***
  - Proprietary Data, Assumptions modified in a series of RTO West public meetings and discussions with operators
  - Model Used : GE MAPS
- ***Henwood Study – October 15, 2004***
  - Proprietary Data, Assumptions discussed in one Grid West meeting and by selected parties
  - Model Used: MARKETSYM – PowerWorld
- ***PacifiCorp – June 14, 2005***
  - SSG-WI and RMATS data developed in a series of public meetings in 2002-2004
  - ABB GridView

TCA Pancake Assumptions

- ***No avoidable wheeling within a system***
  - The MWh delivered to load always pays a wheeling charge to the serving transmission system.
  - Does not effect dispatch.

- ***Base Case: all wheels between systems face pancaking***
  - Wheels between systems are on PTP
  - PTP can be resold thus has an opportunity value
  - Does effect dispatch

Henwood Pancake Assumptions

- ***No avoidable wheeling within a system***
  - The MWh delivered to load always pays a wheeling charge to the serving transmission system.
  - Does not affect dispatch decision.

- ***Base Case: some wheels between systems face pancaking***
  - Only "when BPA paths are full and other non BPA facilities must be used" does the analysis reflect pancaked transmission rates. (Henwood, p. 4-1: 3-5, 3-6)
  - Does affect dispatch decision.

PacifiCorp Pancake Assumptions

- ***No avoidable wheeling within a system***
  - The MWh delivered to load always pays a wheeling charge to the serving transmission system.
  - Does not effect dispatch.
- ***Base Case: all wheels between systems face pancaking***
  - Wheels between systems are on PTP
  - There "friction" costs in the base case that GridWest would reduce
  - PTP can be resold thus has an opportunity value
  - Does effect dispatch

TCA Pancaking Savings (Fuel Costs or Societial)

- Base Case w/ Pancakes, RTO West Case w/o Pancakes in the Grid West footprint
- Started from $239 Million in Fuel Savings and Accepted all but one adjustment suggested by the "TCA Critique" paper, Wolverton, et al April 2002
  - Less $150 Million Contingency Reserves
  - Less $27 Million maintenance schedules
  - Less $1 Transactions
- Total Pancaked Savings $61 Million

Henwood Pancaking Savings

- Base Case with some Pancakes, Grid West Case without Pancakes in the Grid West footprint
- $4 Million benefit to Grid West parties (Table 4-1 of Henwood Report)

PacifiCorp Pancaking Savings

- Organized by Control Area
- Base Case: w/ Pancakes between Control Areas (PTP), transactions within CA move for free
- Grid West Case: without Pancakes between CA's in the Grid West footprint
- Base Case has additional "Friction" ($1.50/MWh) to pancake, Grid West Case cut friction in half
- Runs with 100% Transmission Capacity available as well at 90% available
- Grid West Fuel savings averaged $20 Million

Benefit Estimates

- *High:* *$61 million per year*
- *Medium:* *$20 million per year*
- *Low:* *$4 million per year*

Example of Transaction Friction on Transmission Usage

- **Path 49 (East of Colorado River) usage in 2003**
- **SP15 and PV prices in 2003**
  - **Incomplete or costly information**
  - **High transaction costs**

Total MW Schedule (2003 Sum)		39,151,656	61%
Total MW Flow (2003 Sum)		35,010,008	55%
Total MW Capacity (2003 Sum)		64,146,843	
Path Rating MW Max		7,550	
# Hours Transmission under-used or mis-used		8,760	
Minimum East to West MW Flow		2,030	
Minimum East to West MW Schedule		888	
% of Time E-W Schedule below 2000 MW		0.5%	
Hours when Spread Justify additional flow to SP with $8/MWh Pancake and no constraint		1,994	23%
Spread Value of Unused Transmission (Spread less $8/MWh times Avail. Trans)	$	38,286,978	
Number of Hours PV>SP 15		3,327	38%
Spread Value of Misdirected Schedule	$	92,108,824	
# Hours Transmission underused or misdirected	$	5,321	61%
Hours Observed		8760	100%

Reconfiguration/ Single Scheduling Entity: Increased Transmission Utilization

Reason to Expect Grid West Improvements

- ***Creates a secondary market for transmission rights acquisition***
  - Resolves the mismatch between Contracts and Needs
  - Rights clear at perceived market value, not transmission cost cap
  - Provides hedge against pre-schedule congestion

- ***Single independent entity coordinating schedules flow-based Injection-Withdrawal Scheduling Practices***
  - Resolves most of the mismatch between Contractual Path and actual Power Flow within the Grid West Footprint
  - Simplifies control area scheduling requirements

How Measured

- ***Ran several ABB GridView model runs***
  - **Without** GridWest Transmission Capacity
    - 100% of TTC/OTC
    - 90% of TTC/OTC
  - **With** GridWest Transmission Capacity
    - 100% of TTC/OTC
    - 95% of TTC/OTC
    - 90% of TTC/OTC

Benefit Estimates

- Improving transmission Capability 10% saved about **$52 million per year** in variable generating costs (fuel and non-fuel VOM)
- Improving transmission Capability 5% saved about **$30 million per year** in variable generating costs (fuel and non-fuel VOM)
- Interpolating for 3% indicates a savings of **$18 million per year** in variable generating costs (fuel and non-fuel VOM)

Quantification Recap

Summary of Quantified Benefits - 4 CCA

		4 Consolidating Control Areas		
		High	Medium	Low
	Cost Saving Category	$ million/year		
1	Contingency Reserves	39	30	20
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Summary of Quantified Benefits - 10 CCA

		10 Consolidating Control Areas		
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Construction Deferral

Construction Deferral

- ***In addition to fuel savings, Grid West can facilitate deferral of new transmission, distribution and generation capacity.***
  - GW design allows increased utilization of existing facilities
    - Allows for additional long term ATC contracts reducing the need for transmission construction
    - Additional ATC allows bottlenecked or surplus generation to be used and existing generation used for ancillary services delaying need for new generation
  - GW markets allow for visible and locational price information that :
    - Allow better long term siting decisions
    - Facilitates conservation and DSM; dispatchable and non-dispatchable (addressed in next section)
  - GW Planning
    - Common queue, project clustering, combined planning, reduce the need for duplicative capacity
- ***Benefits accrue from decreased and delayed Capital carrying costs***

Construction Deferral

- ***Capacity studies being preformed, almost complete***
- ***Examples of Capacity deferrals***
  - BPA changes in ATC methodology
    - Partial region and semi-flow based ATC changes provide additional long term ATC on BPA system, approx. 2600 MW
    - GW model will facilitate wider application and solve existing issues
      - Congestion redispatch
      - Reconfiguration Service
  - Additional E-W transmission could delay East side generation for Ancillary Services
  - Examples: 2 year deferral of: Annualized savings

Examples: 2 year deferral of:	Annualized savings
236 MW East side GT	$4 Million
Large NW transmission project	$14 Million
300-500 MW NW generation resource	$20 Million

Assumptions Behind DSM Estimates

- Based on results from SSG-WI October 2003 Report
- Grid West's share of WECC is 28%.
- Conservation costs $1.5 million to $2.0 million per a MW
  - Terms: 11% over 15 years
- Conservation attributed to Grid West will displace some generation and transmission.
- T&D not accounted for in WECC study is assumed to be twice the capital cost amount included in bulk transmission needs
- Grid West would accelerate deployment of conservation measures in the region through RCS auctions, demand response to RBS
- Variable O&M (VOM) costs in SSG-WI report are conservative because gas price assumptions are based on 2002 forecasts ($3 - $4 per mmBTU)

Results from October 2003 SSG-WI Report: WECC Wide

- ***Gas Scenario***
- ***2008 to 2013 Load Increase:***

  866,546,520 → 954,480,068 = 97,933,548 MWh

  or 11,180 aMW
- ***2008 to 2013 Increase in Variable O&M***

  $15,070 M → $16,623 M = $1,553 M

  or $15.9 M per year → $138,867/aMW
- ***2013 Capital Required: $1,784 M***

  or $159,576 per aMW

- ***Total VO&M + Capital = $298,442/aMW per year***

Annualized Benefit of Conservation

- ***Costs of Conservation per aMW per year and Differences from SSG-WI Assessment***

Range	Conservation Estimate	SSG-WI 2003 Gas	Differences from SSG-WI
Low:	$208,560	$298,443	$89,845
High	$278,130	$298,443	$20,312

Estimated Benefits of Conservation

Attainable Conservation As % of load Growth	Attainable Conservation aMW	Adjusted for Losses	Savings per aMW/year $million/year	
			High	Low
50	1,565	1,739	$156	$35
25	782	869	$78	$17
10	313	348	$32	$7

Notes:

- Column 2 is 28% of WECC values times Column 1
- Losses are estimated to be 10% from Generator to Customer

Range of Benefits Attributable to Grid West

- Assume Grid West's RCS is responsible for 10-20% of Savings

- High Benefit – $31 million per year

- Low Benefit – $.7 million per year

SSG-WI Transmission Expenditures

- $2.6 billion over 5 years, or $500 million per year
- 28% or $150 million per year in Grid West service territory
- Bulk Electric System only
- Does not include distribution or subtransmission facilities

→ Additional savings potential!

Other T&D Not Included in SSG-WI

- Certain Transmission and Distribution facilities were not counted in SSG-WI studies
- The growth per year of capital for other T&D is assumed to be double the amount required for Bulk Electric System upgrades
- Conservative estimate of $300 million per year in Grid West

Savings Associated with Non-Bulk Electric System T&D

Conservation attainable as a percentage of peak load growth	Expected expenditures on T&D not previously counted per year ($millions)	Savings in T&D ($millions)	Savings per year if Grid West accounts for 20% of these savings ($millions)	Savings per year if Grid West accounts for 10% of these savings ($millions)
50	$300	$150	$30	$15
25	$300	$80	$16	$8
10	$300	$30	$6	$3

Total Estimated Benefits Accruing to Conservation Due to Grid West

($million/year)

- ***Low*** ***$3.7***

- ***High*** ***$61.0***

  – Does not include other non-wires measures that would

  – contribute to Grid West efficiencies.

Market Innovation Potential

- Tabor Caramanis and Henwood did not consider benefits from technological and strategic innovations made possible by making access to markets easier.

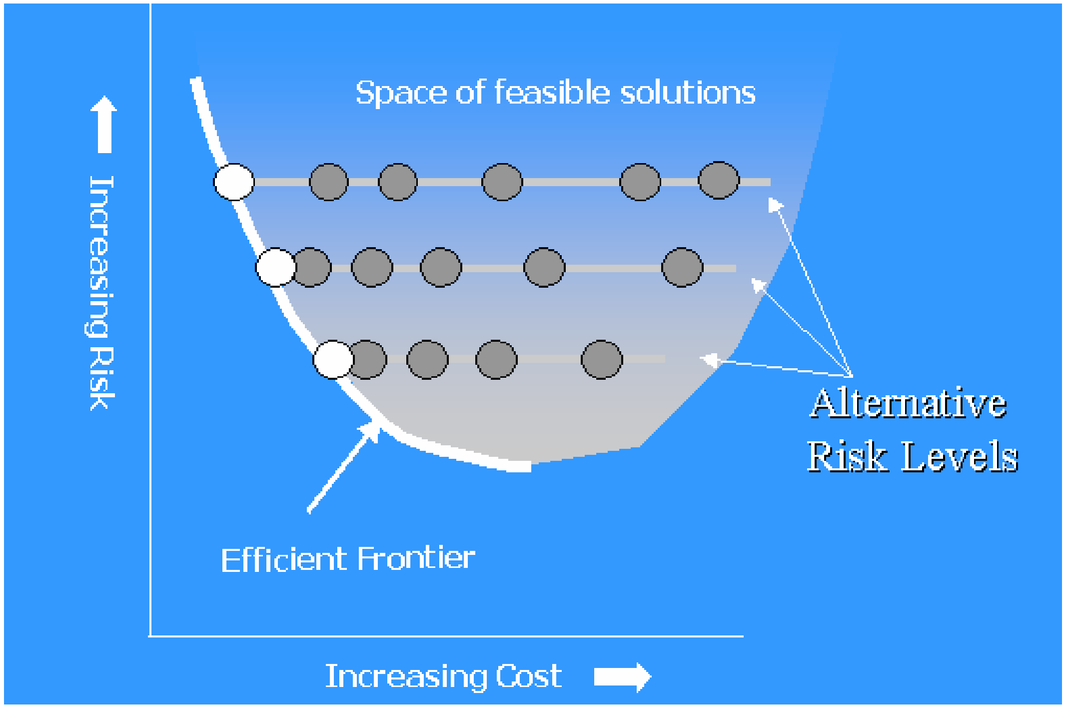
- These benefits could far exceed those that come simply from more efficient operation of the grid.

- Grid West has the potential to make innovation more likely

Market Innovation Potential

– NWPPC assessment of costs versus risks.

– Removing conservation and replacing it with ANY resource moves every point on the efficiency frontier to the northeast. (i.e. increases cost AND risks)



Market Innovation Potential

– The status quo will result in continued transmission centric planning for transmission and continued balkanized planning of the “big machine.”

– Loads will continue to use power regardless of system conditions, unless emergency conditions force them, or cajole them, to do otherwise.

– And generators will continue to be sited where lower bus bar costs are possible, without regard for the differential costs that occur throughout the grid.

Market Innovation Potential

– Activities spurred by the promise of Grid West, such as TIG and others, will undoubtedly result in some movement before Grid West is operational.
– But, that progress will be slow without comprehensive strategies in place to allow non-wires strategies and other innovations to make a difference.
– Need a market mechanism (e.g. RCS) to bring these fruits to bear.

What Others are Saying...

- ***Merrill Lynch has looked at the electricity sector and concluded that if the Public Utility Holding Company Act (PUCHA) were repealed, companies like General Electric could take over the industry.***
- ***ML's position is based, in part, on the large amount of capital used in the industry and the relatively low capacity factor associated with that capital.***
  - The electric utility industry capital investments in 1998 were about $600 billion and growing at about 6$ billion per year .
  - Further this capital is used on average 43% of the time. If PUCHA is repealed, as it appears it might be, there will be different entries coming into the electric industry.
  - These entities, not steeped in historical practice, will undoubtedly be looking for more efficient ways of delivering services to their customers

What Others are Doing...

- *EPRI and others, including BPA, are working on the "Self Healing Grid". These efforts will almost assuredly bring changes to the electricity grid if markets are open through the advent of an independent operator.*

- *PNNL and Motorola e.g.. are working on installing a smart chip in appliances that will automatically respond to grid conditions (frequency, voltage, shutoff)*

- *Vehicle-to-grid (V2G) applications. Using this technology, electric vehicles become energy storage devices on the power grid with the ability to regulate load and even deliver power to the grid for short periods. Already being employed in Europe.*

What Others are Doing...

- *Innovative strategies with open markets to offer services into Grid West*
  - Aggregators of loads e.g.

- *Venture capitalists are investing millions of dollars to develop better fuel cells, better fuel reformers to produce hydrogen to drive these fuel cells, and even into creating cost-effective streams of hydrogen from waste byproducts of other industries*

- *Fuel cells are being designed and applied to run individual appliances; if successful on a grand scale this technology could change how we plan and operate the power grid.*

- *Any or all of these efforts could be spurred by a Grid West design that accommodates the introduction of innovations.*

- *We should be vigilant in making sure that Grid West does not become "transmission centric."*

All that is needed is the opportunity. Well-designed Grid West markets that have easy entry will enhance the probability that innovations will come forward to make the grid a more efficient machine.

Grid West